

The Rufford Foundation

Final Report

Congratulations on the completion of your project that was supported by The Rufford Foundation.

We ask all grant recipients to complete a Final Report Form that helps us to gauge the success of our grant giving. The Final Report must be sent in **word format** and not PDF format or any other format. We understand that projects often do not follow the predicted course but knowledge of your experiences is valuable to us and others who may be undertaking similar work. Please be as honest as you can in answering the questions – remember that negative experiences are just as valuable as positive ones if they help others to learn from them.

Please complete the form in English and be as clear and concise as you can. Please note that the information may be edited for clarity. We will ask for further information if required. If you have any other materials produced by the project, particularly a few relevant photographs, please send these to us separately.

Please submit your final report to jane@rufford.org.

Thank you for your help.

Josh Cole, Grants Director

Grant Recipient Details	
Your name	Raphael Reinegger
Project title	The effects of fruit availability on diet composition and feeding behaviour of invasive <i>Macaca fascicularis</i> in Mauritius: implications for conservation of <i>Pteropus niger</i> and native forests
RSG reference	27571-2
Reporting period	2019 – 2020
Amount of grant	£5000
Your email address	raphael_reinegger@hotmail.com
Date of this report	22-03-2020

1. Please indicate the level of achievement of the project's original objectives and include any relevant comments on factors affecting this.

Objective	Not achieved	Partially achieved	Fully achieved	Comments
Quantify macaque damage to native plants in a remnant forest in Mauritius				Because of several setbacks caused by radio-collaring macaques and difficult terrain (please find detailed discussion of this issue in the extensive report), only 2 months of data could be collected. However, the findings obtained during this study time have provided extremely valuable insights into macaque ecology and fruit scarcity in Mauritius. However, it will be crucial to continue this study until the end of 2020.
Study relationship between seasonal fruit availability, ranging patterns and diet composition of macaques in a remnant forest in Mauritius.				This objective was added after obtaining the Rufford grant. Measuring monthly fruit availability in our study site was perfectly manageable together with collecting behavioural data on macaques. This was a valuable addition to the project since fruit availability can reveal dietary patterns of macaques and provide information about fruit scarcity.
Estimate home range of macaque troop				Home range of the study troop has been estimated for 2 months. However, home range may still vary during the year.
Estimate macaque density to provide a new population estimate				The troop size is known but home range may still vary. Therefore, macaque density may be lower or higher than presented in our extensive report.
Initiating a study on the effects of weed removal on fruit production of native plants				This experiment has been set up successfully and fruit production of native trees has been monitored in 15 plots of 10 x 10 m in an un-weeded condition. Plots will be weeded at the end of this fruiting season (April 2020), so that fruit production can be measured again for two consecutive fruiting seasons.

2. Please explain any unforeseen difficulties that arose during the project and how these were tackled (if relevant).

This study originally started as a radiotracking study in August 2019. Baiting and trapping procedures took a considerable amount of time (2 months), since the ranging patterns of the macaque in our study site were unknown. A total of five macaques were trapped and radio collared. However, these individuals were terrified of people after this event. We tried to establish contact with the radio-collared individuals for over 1 month, but this was impossible in the dense vegetation of our study site. Remarkably, the individuals appeared to have been shunned by their troop, since the rest of the troop was encountered coincidentally. These individuals were much more at ease with the researcher. This troop was then habituated during October – November 2019. Radio signals were frequently checked to confirm that radio collared individuals foraged far away from the study troop. As a result, data could not be collected until December. Additionally, data could not be collected in January because of the frequent torrential rains and cyclones.

3. Briefly describe the three most important outcomes of your project.

We found that *M. fascicularis* spends most of its time feeding (53%) and moving (20%), similar to other studies of *M. fascicularis* in degraded habitat. Moreover, we found a large number of indicators for fruit scarcity in our study site. A large proportion of the diet of *M. fascicularis* during this study consisted of pine cones (44% in December, 64% in February). Before this study, no macaque species has been reported to feed predominantly on pine cones. Howler monkeys in Argentina are known to feed on pine cones during periods of fruit scarcity, and just like *M. fascicularis*, they adapt extremely well to habitat disturbed by humans. Macaques spend more time feeding on leaves, immature fruit and flowers during periods of fruit scarcity, since ripe fruits are typically a preferred food source. If we can assume that pine cones are more difficult to digest and thus a lesser quality and less preferred food item than fruit, we expect the proportion of pine cones in the diet to decrease with increasing fruit availability. Fruit availability is currently still increasing, and we expect to see a diet shift within the next couple of months.

Another indicator for fruit scarcity is that *M. fascicularis* consumed predominantly unripe fruit during this study. All fruit in the diet was unripe, except for one species. This species comprised the majority of the fruits in *M. fascicularis* diet. Feeding on immature fruit is considered a response to fruit scarcity, just like feeding on pine cones. Furthermore, native fruit availability was also low compared to exotic fruit availability, which was reflected in the relative use of native compared to exotic fruits by *M. fascicularis*.

Additionally, *M. fascicularis* ate large quantities of unripe fruit of several species and we found that a single macaque can easily deplete fruits on native trees within minutes. Of all species recorded along our phenology transects, only one species (*Litsea* sp.) produced ripe fruits during our study period. Additionally, average fruit yield of many species was extremely low, and yield was extremely variable. The

majority of many native and exotic trees produced no fruit during our study. Our most striking example was *Eugenia pyxidata*, which produces little fruit on average and is scarce in the study area. The large quantities of unripe fruit eaten by a single macaque within a single feeding event indicate that fruit of this species is depleted at an unripe stage. This would mean that the diet of the endemic flying fox *Pteropus niger* is restricted, since it eats mostly ripe fruit and *Eugenia* species are known to be included in its diet. Additionally, by consuming unripe fruit, seeds are typically destroyed. Therefore, the exclusive consumption of unripe fruit of many species by *M. fascicularis* is not only likely to limit availability to *P. niger* but also halt plant reproduction. It is likely that fruit scarcity promotes the consumption of unripe fruit by *M. fascicularis*. However, it will be crucial to collect additional months of data to test the hypothesis that fruit is a preferred resource. Moreover, it will be valuable to measure pine cone availability.

Finally, the macaque density found during our study is considerably higher than in previous studies. This indicates that the population has increased. However, it will be valuable to collect additional data, since the home range may still vary during the year.

The detailed outcome of this study is provided in the extensive report.

4. Briefly describe the involvement of local communities and how they have benefitted from the project (if relevant).

N/A

5. Are there any plans to continue this work?

We plan to continue this study until the end of this year, to test the effect of fruit availability on the proportion of fruit in the diet of *M. fascicularis*. Furthermore, we plan to test the hypothesis that *M. fascicularis* destroys more unripe fruits during periods of low compared to high fruit availability. Additionally, we have not managed to quantify damage to many native plants, because of the difficulties in following our troop in native forest. Feeding in native forest was typically under-represented, because stem density here was high and the canopy low. The troop is still relatively nervous around the researcher in the patches of native forest in our study site, which are all restricted to slopes and ridges. As they become increasingly habituated, we will get a more complete picture of their diet composition and fruit damage. Furthermore, we plan to study the relationship between ranging patterns and fruit availability, since fruit scarcity may promote energy maximising strategies.

6. How do you plan to share the results of your work with others?

This report will be shared with the National Parks and Conservation Service and Forestry Service, two local government organisations involved with the protection and conservation of native forests. Additionally, a copy will be provided to Noveprim Ltd., the monkey breeding organisation that was involved with baiting and trapping procedures. They are one of three organisations that have a responsibility towards

the government in controlling macaque populations in Mauritius and are extremely interested in the results of this study.

7. Timescale: Over what period was The Rufford Foundation grant used? How does this compare to the anticipated or actual length of the project?

The grant was used between July 2019 and February 2020. However, a lot of time was lost because of radiotracking attempts. Troop habituation seems to be a much more effective method for collecting behavioural data. Nevertheless, the weeding experiment was successfully established between July and August 2019.

8. Budget: Please provide a breakdown of budgeted versus actual expenditure and the reasons for any differences. All figures should be in £ sterling, indicating the local exchange rate used.

Item	Budgeted Amount	Actual Amount	Difference	Comments
Accommodation	1200	1200		Rent was paid with personal funds.
Fuel	600			
Living allowance	2400	2400		The majority was paid with Rufford funds (1555) and a smaller portion with personal funds (845).
Transport	480	2400		Transport and fuel were paid with personal funds
Radio-collars		3125		Radio-collars were bought with Rufford funds since additional funding from the Prince Bernhard Foundation could not be acquired.
Fabric, string and pvc pipes for seed traps	320	320		Bought with Rufford funds
Hand GPS		60		Bought with personal funds.
Stationary		20		Personal funds.
TOTAL	5000	9525	+4525	

Originally, I applied for additional funding from the Prince Bernhard Foundation for radio-collars. Unfortunately, these funds could not be acquired. Therefore, Rufford funds were used to pay for the radio-collars and personal funds were used to cover some of the costs that were originally going to be covered by the Rufford grant.

9. Looking ahead, what do you feel are the important next steps?

It will be important to continue the current study until the end of the year and also measure pine cone availability. An additional transect will be established to measure this. Additionally, the diet has started shifting to fruits this month (March 2020). However, we were not able to include March in the report since data on fruit availability still has to be collected this week. Nevertheless, we are very excited about the months to come, since these will likely reveal clearer dietary patterns of our macaques. Furthermore, it will be valuable to hire a field assistant, since it would make data collection considerably less challenging.

Moreover, the first fruiting season is coming to an end. Therefore, weeding activities will have to be carried out within the next couple of months. Staff will have to be hired in order to weed the plots established for monitoring fruit production of native trees. Moreover, a field assistant will have to be hired to assist with data collection for this weeding experiment at the end of the year.

10. Did you use The Rufford Foundation logo in any materials produced in relation to this project? Did The Rufford Foundation receive any publicity during the course of your work?

Rufford was acknowledged in my presentation on the research funded by my first Rufford grant at the Island Biology conference in Réunion in July 2019. However, the current work has not been presented yet.

11. Please provide a full list of all the members of your team and briefly what was their role in the project.

Professor Gareth Jones – Gareth is based at the University of Bristol and is the main supervisor of this study.

Dr Ryszard Oleksy – Ryszard provides accommodation and transport for this study in Mauritius. He is based in Mauritius and also provided advice on the design of this study.

Houshna Naujeer – Houshna is a scientific officer at the National Parks and Conservation Service (NPCS) who oversees the progress of my work, since the findings of this study are relevant to conservation policy in Mauritius.

Ismael Janoo – Ismael is a field staff member at the Ecosystem Restoration Alliance (ERA) and has assisted with field activities.

Dr Claudia Baider – Claudia is the manager of the National Herbarium and an amazing botanist. She provided assistance with plant identification and has also advised me on the design of the weeding project.

Dr Vincent Florens – Vincent is a brilliant ecologist and has provided advice on the design of the weeding experiment.

12. Any other comments?

I am looking forward to continuing this study and I am planning to submit a new proposal within the next 2 weeks.

